

U.S Integrated Earth Observation System

Sea Level Observation System: Integrated Information System

Preamble

The USGEO is coordinating the activities to formulate integration framework documents for the six near-term opportunity areas identified in the Strategic Plan for the U.S. Integrated Earth Observation System.

One of the steps is to take inventory of the Earth observation systems, models, and decision support systems that exist or are planned to be developed over the coming years. The following tables are initial compilations of U.S. capabilities in Earth observation systems, models and decision support systems. Earth observation systems, models, and decision support systems identified in the tables are candidates for inclusion in Integrated Earth Observation System configurations for each of the near term opportunity areas.

These tables are draft and as such, are neither exclusive nor comprehensive. We invite interested members of the community to provide input to the content of these tables and system configurations – both during the sessions on the second day of the IEOS Public Engagement Workshop and through email submissions to the USGEO. Your review and input to these tables and to the Integrated Earth Observation System configurations for each of the near term opportunities is greatly valued and appreciated.

Draft Table 1. Products, Services, Observing Systems and Models

Products/Services	Observing System/Model	Instrument/Parameter	Agency
Sea level	Global Sea Level Network (GSLN)	Sea Level Gauges	NOAA – Surface/Subsurface
Bathymetry	Hydrographic Surveying	Side Scan Sonar Multibeam Sonar Single Beam Echo Sounder	
Water current speed	National Current Observation Program (NCOP) ¹	Water Current	
Water Level	National Water Level	Water Level Gauges	

¹ Draft IEOS Data Management Plan, p. 17.

² Ibid

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
Wind Speed	Observation Network (NWLON) ²	Anemometer	
Wind Direction			
Water Temperature		Water Temperature Sensor	
Air Temperature		Air Temperature Sensor	
Water Current	Physical Oceanographic Real-Time System	Water Current	
Wind Speed		Anemometer	
Wind Direction			
Water Level		Water Level Gauges	
Water Temperature		Water Temperature Sensor	
Air Temperature		Air Temperature Sensor	
Wind Direction	National Estuarine Research System-Wide Monitoring Program	Wind Anemometer	
Wind Speed			
Air Temperature		Air Temperature Sensor	
Precipitation		Precipitation gage	
Water Temperature		Water Temperature Sensor	
Salinity		Salinity	
Conductivity		Specific Conductivity	
Depth		Depth	
Nutrients		Nutrients	
Turbidity		Turbidity	
Precipitation	Automated Surface Observing System (ASOS)	Heated Tipping Bucket	
Wind Speed		Wind Sensor	
Air Temperature	NDBC Moored Buoy	Thermistor (Air)	
Wind Direction		Anemometer	
SST		Thermistor	
Wave Period		Inclinometer	
Current		Acoustic Doppler Current Profiler	
Maximum and Minimum Air Temperatures	Cooperative Observer Program	Maximum Minimum Temperature System	
Precipitation		Fisher-Porter/Belfort Rain Gauge	
Water Column Height	Deep-ocean Assessment and Reporting of Tsunamis	Paros Pressure Sensor	
River Stage	Limited Automated Remote Collector	Stage Height	
Precipitation		Precipitation gage	
Wind Speed	Coastal-Marine Automated Network	Anemometer	
SST		Thermistor (Sea Surface)	
Tidal Height		Tide Gauge	
Precipitation	Next Generation Weather Radar	Radar Reflectivity	
Wind Direction		Radial Velocity	

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
		Spectrum Width	
Air Temperature	Voluntary Observing Ship Program	Hygrometer	
SST		Thermistor	
Ocean Salinity Profile	ARGO Profiling Floats	Conductivity Sensor	
Ocean Temperature Profile		Temperature Sensor	
SST	ENSO OS Drifting Buoys	Sea Surface Temperature Sensor	
Wind Direction		Anemometer	
SST	GOOS/VOS/XBT	Sea Surface Temperature sensor	
Ocean Temperature Profile		Expendable Bathythermograph	
Air Temperature	Long Term Evolution of the Coupled Boundary Layers	Improved Meteorological System	
Wind Speed			
Wind Direction			
Precipitation			
SST		Floating Sea Surface Temperature Recorder	
Water Temperature		Floating Sea Surface Temperature Recorder	
Subsurface-Water Temperature		SeaCat Conductivity and Temperature Recorder	
		Brancker Temperature Recorder	
		Sea-Bird Temperature Recorder	
Subsurface-Ocean Current Speed		Vector Measuring Current Meter	
Subsurface-Ocean Current Direction		Aanderaa Recording Current Meter	
Subsurface-Ocean Current Speed		Falmouth Scientific Instruments Current Meter	
		RD Instruments Workhorse Acoustic Doppler Current Profiler	
Chlorophyll		Chlorophyll Absorption Meter	
Precipitation		Acoustic Rain Gauge	
Wind Speed	Tropical Atmosphere Ocean Array	Wind Anemometer	
Wind Direction			
Temperature	Global Surface Network (GSN)	Temperature Sensor	
Precipitation		Precipitation gage	
Atmospheric Moisture	Polar-orbiting Operational Environmental Satellite	High Resolution Infrared Sounder	NOAA-Spaceborne
Atmospheric Temperature			
Global Vegetation Index		Advanced Very High Resolution Radiometer	
Sea Surface			

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
Temperature			
Visible Imagery			
Precipitation		Advanced Microwave Sounding Unit-A	
Snow Cover			
Sea Ice Extent			
Atmospheric Moisture		Advanced Microwave Sounding Unit-B	
Precipitation			
Snow Cover			
Sea Ice Extent			
Land Surface Temperature		Geostationary Operational Environmental Satellite I-M	
Ocean Surface Current Analysis			
Precipitation			
Sea Surface Temperature			
Atmospheric Moisture			
Atmospheric Temperature	Sounder		
Land Surface Temperature			
Precipitable Water			
Derived Product Image of Total Precipitable Water			
Land Surface Temperature			
Ocean Surface Current Analysis			
Precipitation			
Sea Surface Temperature			
Land Surface Temperature	Sounder		
Atmospheric Temperature			
Precipitable Water			
Water-leaving Spectral Radiance		Marine Optical Buoy	
	Irradiance		
Atmospheric Temperature Profile	National Polar-orbiting Operational Environmental Satellite System	Conical Microwave Imager/Sounder	
Atmospheric Vertical Moisture Profile			
Sea Surface Winds			
Soil Moisture			
Ice Surface Temperature			
Land Surface Temperature			
Precipitation Type/Rate			

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
Precipitable Water			
Sea Ice Age Characterization			
Sea Surface Temperature			
Fresh Water Ice			
Snow Cover			
Vegetation/Surface Type			
Snow Depth			
Soil Moisture		Visible/Infrared Imager/Radiometer Suite	
Ice Surface Temperature			
Land Surface Temperature			
Precipitable Water			
Sea Ice Age Characterization			
Sea Surface Temperature			
Fresh Water Ice			
Snow Cover		Radar Altimeter Satellite	
Sea Surface Height/Topography			
Ocean Wave Characteristics			
Sea Surface Temperature	NPOESS Preparatory Project	Visible/Infrared Imager/Radiometer Suite	
Land Surface Temperature			
Ice Surface Temperature			
Soil Moisture			
Vegetation Index			
Surface Type			
Fresh Water Ice			
Ocean Color/Chlorophyll			
Snow Cover			
Sea Ice Age Characterization			
	USGS Groundwater Climate Response Network ³		USGS-Surface
			USGS-Model
Land cover	Landsat-5/7 ⁴	Thematic Mapper	USGS-Spaceborne
Land Cover		Enhanced Thematic	

³ Understanding Climate Variability and Change Technical Reference Document

⁴ http://www.asd.ssc.nasa.gov/m2m/mission_report.aspx?mission_id=244

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
		Mapper	
	Experimental Watershed Networks ⁵		DOI-Surface
	SNOw Telemetry ⁶		
			USDA-Surface
	Program for Arctic Regional Climate Assessment (PARCA) ⁷		USDA-Model
	Program for Arctic Regional Climate Assessment (PARCA) ⁸		NASA-Surface
Sea Surface Height	GMAO Ocean ⁹		NASA-Model
Sea Surface Height	LANL POP Ocean ¹⁰		
Floods, snowpack change projections	GSFC LIS ¹¹		
Sea Surface Height	ECCO_OSE ¹²		
Sea Surface Height	GFDL MOM4 Ocean ¹³		
Sea Ice Thickness	LANL CICE ¹⁴		
	Digital Earth Model ¹⁵		
	Global Soil Wetness Project (GSWP) ¹⁶		
	Land Data Assimilation Systems (LDAS) ¹⁷		
	Program for Arctic Regional Climate Assessment (PARCA) ¹⁸	Laser-altimetry	NASA-Airborne
Land cover type	Aqua	MODIS ¹⁹	NASA-Spaceborne
Sea ice concentration		AMSR-E ²⁰	
Land cover classification	Terra	MODIS ²¹	
Antarctic and Greenland Ice Sheet	GLAS/IceSat	GLAS ²²	

⁵ Understanding Climate Variability and Change Technical Reference Document

⁶ Ibid

⁷ Climate and Cryosphere (CliC) Project Science and Co-ordination Plan Version 1, p. 35.

⁸ Climate and Cryosphere (CliC) Project Science and Co-ordination Plan Version 1, p. 35.

⁹ http://www.asd.ssc.nasa.gov/m2m/model_report.aspx?model_id=115

¹⁰ http://www.asd.ssc.nasa.gov/m2m/model_report.aspx?model_id=100

¹¹ http://www.asd.ssc.nasa.gov/m2m/model_report.aspx?model_id=109

¹² http://www.asd.ssc.nasa.gov/m2m/model_report.aspx?model_id=108

¹³ http://www.asd.ssc.nasa.gov/m2m/model_report.aspx?model_id=111

¹⁴ http://www.asd.ssc.nasa.gov/m2m/model_report.aspx?model_id=117

¹⁵ A Global Water Cycle Theme for the IGOS Partnership, Report of the Global Water Cycle Theme Team, April 2004.

¹⁶ Ibid

¹⁷ Ibid

¹⁸ Climate and Cryosphere (CliC) Project Science and Co-ordination Plan Version 1, p. 35.

¹⁹ http://www.asd.ssc.nasa.gov/m2m/product_report.aspx?product_id=180

²⁰ http://www.asd.ssc.nasa.gov/m2m/product_report.aspx?product_id=633

²¹ http://www.asd.ssc.nasa.gov/m2m/product_report.aspx?product_id=633

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
Altimetry Data			
Sea Ice Altimetry Data			
Sea Surface Height	JASON-1	Microwave Radiometer ²³	
Gravity	GRACE	SuperSTAR	
Cloud Properties	CloudSat	Cloud Profiling Radar (CPR)	
Sea level	TOPEX/Poseidon	Laser altimeter	
		Microwave radiometer	
Height at which snow melts into rain	TRMM ²⁴	Precipitation Radar	
Ocean color data	SeaWiFS ²⁵		
			DOE-Surface
Harmful Algal Blooms	Harmful Algal Blooms Observing System (HABSOS) ²⁶		EPA-Surface
			EPA-Models
			DoD-Spaceborne
Monitor Sea Level	Global Sea Level Observing System (GLOSS) ²⁷	Tide Gauges	Intergovernmental Oceanographic Commission (IOC)
Sea level change	Mass Balance of Arctic Glaciers and Ice Sheets in relation to Climate and Sea Level Changes (MAGICS) ²⁸		
Sea level change	Ice Sheet Mass Balance and Sea Level Contributions (ISMALSS) ²⁹		
Sea level change	West Antarctic Ice Sheet Initiative (WAIS) ³⁰		
Sea level change	Global Land Ice Measurements from Space (GLIMS) ³¹		
Sea level change	International Trans-Antarctic Scientific Expeditions (ITASE) ³²		
Sea level	University of Hawaii Sea		

²² http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=300

²³ http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=712

²⁴ http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=509

²⁵ http://oceancolor.gsfc.nasa.gov/SeaWiFS/BACKGROUND/SEAWIFS_970_BROCHURE.html

²⁶

²⁷ A Global Water Cycle Theme for the IGOS Partnership Report of the Global Water Cycle Theme Team, April 2004.

²⁸ Climate and Cryosphere (CliC) Project Science and Coordination Plan Version 1, p. 60.

²⁹ Ibid

³⁰ Ibid

³¹ Ibid

³² Ibid

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Products/Services	Observing System/Model	Instrument/Parameter	Agency
	Level Center (UHSLC)		
Energy and Land Use	Mini Climate Assessment Model (MiniCAM)		
Sea Level	Model for the Assessment of Greenhouse-gas Induced Climate Change (MAGICC)		
			Any other Contributing Agency -Surface
			Any other Contributing Agency-Model
			Any other Contributing Agency-Spaceborne
1-meter b&w, 4-meter multispectral, 1-meter color, and 1 and 4-meter data bundle	Ikonos ³³	11 bit panchromatic-11 bit multispectral	Space Imaging
Sub meter resolution imagery	Quickbird ³⁴	Panchromatic and multispectral	Digital Globe
4 levels of resolution (2.5m, 5m, 10m and 20m) in b&w and color ³⁵	SPOT ³⁶	Panchromatic and multispectral	SPOT Image

Draft Table 2. Decision Support Systems

Decision Support Tool	Description	Contributing Agencies
Crop Assessment Data Retrieval and Evaluation (CADRE ³⁷)		NASA, USDA
Better Assessment Science Integrated Point and Non-point Sources (BASINS) ³⁸	Facilitate examination of environmental information	EPA, USDA, USGS, BoR
	Support analysis of point and nonpoint source management alternatives	
	Evaluate urban/rural land use	
HAZUS Multi Hazard		
Harmful Algal Bloom		

³³ http://www.spaceimaging.com/products/ikonos/index_2.htm

³⁴ <http://www.digitalglobe.com/about/quickbird.html>

³⁵ http://www.spot.com/html/SICORP/_401_444_449_.php

³⁶ http://www.spotimage.fr/automne_modules_files/standard/public/p445_fileLINKEDFILE_Spot_payload.pdf

³⁷ Draft IEOS Data Management Plan, p. 17.

³⁸ Earth Science 2004 Applications Plan, p.22.

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Decision Support Tool	Description	Contributing Agencies
Bulletin and Mapping System (HAB)		
PECAD		
Advanced Hydrologic Prediction Service (AHPS)		NOAA
Advanced Weather Interactive Processing System (AWIPS)		NOAA
Global Ocean Observing System (GOOS)		
Environmental Public Health Tracking Network (EPHTN)		CDC
Global Earth Observing System of Systems (GEOSS)	GEOSS is envisioned as a large national and international cooperative effort to bring together existing and new hardware and software, making it all compatible in order to supply data and information at no cost. The U.S. and developed nations have a unique role in developing and maintaining the system, collecting data, enhancing data distribution, and providing models to help all of the world's nations. EPA has a strong commitment to the GEOSS initiative.	EPA
NOAA Operational Model Archive and Distribution System (NOMADS)		NOAA
Comprehensive Large Array-data Stewardship System (CLASS)	The Comprehensive Large Array-data Stewardship System (CLASS) is an electronic library of NOAA environmental data.	NOAA
Global Ocean Data Assimilation System (GODAS)		NOAA

Acronym List

A

ACCA	Automatic Cloud Cover Assessment
ADEOS	Advanced Earth Observation Satellite
AGS	Alaska Ground Station
AIRMoN	Atmospheric Integrated Research and Monitoring Network
ALOS	Advanced Land Observing Satellite
AMSR	Advanced Microwave Scanning Radiometer (satellite)
AMSU	Advanced Microwave Sounding Unit (satellite)
ANSS	Advanced National Seismic System
AQI	Air Quality Index
ASAR	Advanced Synthetic Aperture Radar (on Envisat)
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
ATBD	Algorithm Theoretical Basis Document
AU	Astronomical Unit
AVHRR	Advanced Very High Resolution Radiometer
AVIRIS	Airborne Visible-Infrared Imaging Spectrometer

B

BRDF	Bidirectional Reflectance Distribution Function
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C

CCD	Charge Coupled Device
CCSDS	Consultative Committee for Space Data Systems
CCSP	Climate Change Science Plan
CENR	Committee on Environment and Natural Resources
CEOS	Committee on Earth Observation Satellites
CMAQ	Community Multi-scale Air Quality model
COSPEC	Correlation Spectrometer (to detect SO ₂)
CPF	Calibration Parameter File
CRAM	Combined Radiometric Correction Model

D

DART	Deep-ocean Assessment and Reporting of Tsunami
DEM	Digital Elevation Model
DFCB	Data Format Control Book
DHS	Department of Homeland Security
DIS	Data and Information System'
DMSP	Defense Meteorological Satellite Program
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOQ	Digital Orthophoto Quadrangle
DOT	Department of Transportation
DRM	Data Reference Model

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E

ECS	EOSDIS Core System
ECV	Essential Climate Variables
EDM	Electronic Distance Measurement
EOS	Earth Observing System; Earth Observing Subcommittee
EOSAT	Earth Observation Satellite Company
EOSDIS	EOS Data and Information System
EPA	Environmental Protection Agency
EPGS	EOS Polar Ground Sites
EROS	Earth Resources Observation and Science
ERS	European Remote Sensing
ESA	European Space Agency
ET	Evapotranspiration
ETM	Enhanced Thematic Mapper (Landsat instrument)
ETM+	Enhanced Thematic Mapper Plus (Landsat instrument)
EVI	Enhanced Vegetation Index

F

FAC	Full Aperture Calibrator
FDF	Flight Dynamics Facility
FEAF	Federal Enterprise Architecture Framework
FGDC	Federal Geographic Data Committee
FOV	Field of View
FPAR	Fraction of Photosynthetically Active Radiation
FTP	File Transfer Protocol

G

GAW	Global Atmospheric Watch
GCM	General Circulation Model
GCOS	Global Climate Observing System
GEOSS	Global Earth Observation System of Systems
GEOSAT	Geodetic Satellite
GeoTIFF	Geographic Tagged Image File Format
GLOS	Global Land Observation System
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GSD	Ground Sample Distance
GSN	GCOS Surface Network
GTOS	Global Terrestrial Observing System
GUAN	GCOS Upper Air Network

H

HAZUS	Hazards U.S. (FEMA's Hazard and Risk Assessment software package)
HHS	Health and Human Services

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I

IAS	Image Assessment System
IEOS	Integrated Earth Observation System
IFOV	Instantaneous Field of View
IGBP	International Geosphere-Biosphere Programme
IGCO	Integrated Global Carbon Observation
IGOS	Integrated Global Observation System
IGS	International Ground Stations
InSAR	Interferometric Synthetic Aperture Radar
IOC	Initial On-orbit Checkout
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
IWGEO	Interagency Working Group on Earth Observations

J

JPL	Jet Propulsion Laboratory
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L

LAHARZ	Lahar Zonation (lahar run-out model)
LAI	Leaf Area Index
LGS	Landsat Ground Station
LICOR	small infrared analyser for CO ₂ (brand name)
LIDAR	Light Detection and Ranging
LP DAAC	Land Processes Distributed Active Archive Center
LTAP	Long Term Acquisition Plan
LULCC	Land Use and Land Cover Change

M

MASTER	airborne ASTER sensor
ME	Memory Effect
MEASURE	Mobile Emissions Assessment System for Urban and Regional Evaluation
METEOSAT	Meteorology Satellite
MISR	Multi-angle Imaging Spectroradiometer
MMS	Multi-mission Modular Spacecraft
MOC	Mission Operations Center
MODIS	Moderate Resolution Imaging Spectroradiometer
MRLC	Multi-Resolution Land Characteristics
MSCD	Mirror Scan Correction Data
MSS	Multispectral Scanner
MTF	Modulation Transfer Function

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NALC	North American Landscape Characterization pathfinder project with land cover
NASA	National Aeronautics and Space Administration
NCEP	National Centers for Environmental Prediction
NDVI	Normalized Difference Vegetation Index
NED	National Elevation Dataset
NEIC	National Earthquake Information Center
NGA	National Geospatial-Intelligence Agency
NHD	National Hydrography Dataset
NIR	Near Infrared
NISN	NASA Integrated Services Network
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NSF	National Science Foundation
NTO	Near-Term Opportunities
NVEWS	National Volcano Emergency Warning System

O

OMI	Ozone Monitoring Instrument
OP-FTIR	Open-path Fourier Transform Infrared sensor
OSTP	Office of Science and Technology Policy

P

PAC	Partial Solar Calibrator
PAGER	Preliminary Assessment for Global Earthquake Response
PALSAR	Phased Array L-band Synthetic Aperture Radar
PBO	Plate Boundary Observatory (component of Earthscope)
PM	Particulate matter, in sizes less than the number of um stated, e.g., PM2.5
POES	Polar-orbiting Operational Environmental Satellites

Q

QA	Quality Assurance
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R

RADM	Regional Acid Deposition Model
RAQMS	Regional Air Quality Modeling System

S

SAR	Synthetic Aperture Radar
SCIGN	Southern California Integrated GPS Network
SCS	Scan Correlated Shift
SGS	Svalbard Ground Station
SLC	Scan Line Corrector
SMA	Scan Mirror Assembly
SME	Scan Mirror Electronics
SMOKE	Sparse Matrix Operator Kernel Emissions Modeling System

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SNR	Signal to Noise Ratio
SRR	Solid State Recorder
SRTM	Shuttle Radar Topography Mission
SURFRAD	Surface radiation budget network
SWIR	Short Wave Infrared

T

TDRS	Tracking Data and Relay Satellites
TIMS	Thermal Infrared Multispectral Scanner
TM	Thematic Mapper (Landsat instrument)
TOA	Top-of-Atmosphere
TOMS	Total Ozone Mapping Spectrometer
TRMM/PR	Tropical Rainfall Measuring Mission/Precipitation Radar

U

UAV	Uninhabited Aerial Vehicles
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAF	United State Air Force
USDA	United States Department of Agriculture
USGEO	U.S. Group Earth Observations
USGS	United States Geological Survey

V

VAFTAD	Volcanic Ash Forecast Transport and Dispersion model
VIIRS	Visible Infrared Imager/Radiometer Suite
VNIR	Visible & Near Infrared

W

WFF	Wallops Flight Facility
WGS	World Geodetic System
WMO	World Meteorological Organization
WRS	Worldwide Reference System